

1880, Nov. 3.

Dione in conjunction (south) with east end of ring :

h m
 8 50 on the line.
 9 0 certainly just past.

Power 240. Definition not good. At 12^h the satellite was an easy object with the aperture ($9\frac{1}{3}$ in.) reduced to 7 in.

Rhea in conjunction (north) with east end of ring :

h m
 12 5 not up.
 12 7 up?
 12 10 certainly past.

1880, Nov. 19. Good sky. *Enceladus* was seen steadily at 7 P.M.

Rhea in conjunction (south) with preceding end of the ring :

h m
 7 15 not up.
 7 17 up.
 7 20 certainly past.

*Second Catalogue of Radiant Points of Meteors.**

By Edwin F. Sawyer, Esq.

The following list of Meteoric Radiant Points has been deduced from my observations comprising the recorded paths of about 900 out of a total of 1,156 shooting stars seen during the last two years (1879-80) at Cambridgeport, Mass., U.S. The positions deduced mainly consist of those of well-known meteor systems, although the radiant centres of a few strongly suspected and possibly new showers have been determined. A few positions deduced also serve to confirm meteor showers previously observed but once or twice, and needing such verification. Extreme care has been exercised in deducing the results, a certain weight being attached to each meteor mapped, showing the accuracy of the recorded path on a scale of one to four, and its corresponding value used in determining the different centres of

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radiation. The peculiarities of each individual meteor mapped, such as length of path, velocity, magnitude, whether accompanied by streaks or not, &c., have also been regarded in reducing the results, so that the positions as determined may be considered as accurate as the number of meteors mapped and the character of this class of observations will allow. Observations were taken nearly every fine night in the absence of the moonlight (with the exception of during the months of January and February 1879, and March 1880, when sickness prevented), but were confined principally to the evening hours between 7 and 12 P.M. A few morning watches were, however, maintained in April, August, October, November, and December for the appearance of the well-known meteoric showers active during these months.

The period of watching each evening varied from one to five hours in duration, and amounted to 221 hours in all. The observations were almost wholly confined to the eastern and north-eastern quarters of the sky. The showers have (as during my previous observations) been deduced from the material gathered from short periods of watching, the average duration of the showers being about four days. The results, therefore, give the observed duration and not the true period of each shower, as yet an uncertain element in the majority of showers now catalogued. The following table exhibits, 1st, the days each month on which observations were obtained; 2nd, the number of hours spent in watching; 3rd, the number of meteors recorded; 4th, the number of radiant points deduced; and 5th, the number of meteor tracks employed in determining the radiant centres.

Months and Days.	Hours.	No. of Meteors seen.	No. of Radiant Points deduced.	No. of Meteor Tracks used.
1879, January and February. None ...	0	0	0	0
March 18, 19	2	7	0	0
April 12, 14, 19-23, 26 ...	16	56	6	32
May 8, 9, 11	3	11	0	0
June 8, 13, 17, 18, 21, 23 ...	6	26	1	9
July 12-14, 17, 19	8	26	3	15
August 7, 10-12, 20	10	171	10	71
September 8, 9, 11, 14, 15, 17, 20	11	45	3	27
October 7, 13, 14, 19, 20 ...	13	77	11	54
November 7, 10, 15, 16 ...	11	60	5	31
December 7, 9, 12, 16 ...	11	69	4	43
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Total 49 days ...	91	548	44	282

Months and Days.	Hours.	No. of Meteors seen.	No. of Radiant Points deduced.	No. of Meteor Tracks used.
1880, January 2, 5, 7, 8, 10 ...	13	36	2	13
February 1, 6, 7, 8 ...	6	12	2	6
March. None ...	0	0	0	0
April 5, 7, 8, 12, 30 ...	8	17	0	0
May 2, 6, 8, 10, 11 ...	6	13	0	0
June 29, 30 ...	3	12	2	9
July 4, 7, 28-31 ...	13	99	8	65
August 1, 6, 8, 9, 26, 28, 31 ...	16	172	9	79
September 1-4, 11, 24, 25, 28-30	19	64	5	37
October 1-3, 5, 6, 8, 9, 24, 25, 29, 31	27	113	10	53
November 1, 2, 11, 12, 25, 26, 29	18	68	2	17
December 3 ...	1	2	0	0
Total 63 days ...	130	608	40	279
1879 ... 49 days	91	548	44	282
1880 ... 63 ,,	130	608	40	279
Grand Total ... 112 days	221	1156	84	561

The estimated magnitudes of the meteors seen were as follows :—

>1st.	=1st.	=2nd.	=3rd.	=4th and fainter.	Total.
76	142	201	280	457	1156

Of the meteors >1st mag. in brightness, there were 3 > ♀, 3 = ♀, and 32 equal or exceeding ♀ in brilliancy. 79 of the 218 meteors = or >1st mag. in brightness were noted as exhibiting more or less colour, as follows :—8 were classed as deep orange, 39 orange, 4 yellow, 12 green, and 16 blue. The average length of path of the 912 meteors mapped was 9° 9'. The following list of stationary, or nearly stationary, meteors have been recorded during the past two years :

Stationary Meteors.

No.	Date.	Position.	Mag.	Weight.	Remarks.
1	1879, March 15	195° - 5°	3	3	
2	19	198° + 7½°	4	4	Slight movement, about ¼°
3	April 12	223 - 2	1	3	Very slight movement; visible 1°
4	14	206 - 8	2	4	
5	14	205 - 2 to 204 - 1½°	3	4	Path 1°
6	14	207 + 25	3	3	
7	21	238 - 7	4	3	
8	21	262 + 17	4	3	
9	22	253 + 5	1	3	

No.	Date.	Position.	Mag. Weight.		Remarks.
10	1879, May 9	$275^{\circ} + 12^{\circ}$	2	3	1 sec.
11	9	$225 + 3$	1	3	Nearly stationary, path $\frac{1}{4}^{\circ}$
12	June 8	$259 + 11$ to $259\frac{1}{2} + 10$	3	1	Path 1°
13	13	$282\frac{1}{2} + 20$	4	3	
14	23	$298 + 27\frac{1}{2}$ to $298 + 26\frac{1}{2}$	4	3	Path 1°
15	July 12	$325 + 28$	4	3	Slight movement, $\frac{1}{2}^{\circ}$
16	Oct. 13	$11 + 40$	4	3	
17	14	$22 + 21$	2	4	Nearly stationary, yellow.
18	19	$18 + 29$	5	3	
19	19	$92\frac{1}{2} + 24\frac{1}{2}$ to $91\frac{1}{2} + 24$	1	4	Slight movement.
20	Nov. 7	$42 + 32$	4	3	
21	10	$54 + 2$	3-5	4	Two seen within the space of 3 seconds from apparently the same point.
22	10	$87\frac{1}{2} + 19$ to $88 + 18$	5	3	Slight movement.
23	16	$69 + 15$	5	4	
24	Dec. 12	$117 + 11$	> 1	3	
25	12	$106 + 24$	4	3	
26	12	$117 + 24$	4	4	Nearly stationary, from direction of β Geminorum.
27	12	$112\frac{1}{2} + 2$ to $112\frac{1}{2} + 1$	3	3	Path 1°
28	1880, Jan. 2	$102 + 10\frac{1}{2}$ to $102 + 9\frac{1}{2}$	4	3	Path 1°
29	7	$98 + 3$	4	3	Path $\frac{1}{2}^{\circ}$
30	Feb. 8	$148 + 22$	5	4	
31	April 30	$236 + 19$ to $235 + 19$	2	2	Path 1°
32	May 8	$257 + 1$	4	3	Slight movement.
33	11	$181 - 8$	4	3	Visible 1 sec.
34	June 29	$316 - 11$	4	4	Visible 1 sec. accu- rate.
35	July 30	$10\frac{1}{2} + 50$ to $10\frac{1}{2} + 51$	2	4	Path 1°
36	Aug. 8	$102 + 58$	1	3	Slow; 1 sec.
37	9	$21 + 39$	4	4	
38	9	$44\frac{3}{4} + 56\frac{1}{4}$	1	4	Visible 2 sec.
39	9	$55 + 57$	1	4	Visible 1 sec.
40	26	$348 + 16\frac{1}{2}$	3	4	Slight movement.
41	Sept. 29	$6 + 5\frac{1}{2}$ to $6 + 4\frac{1}{2}$	5	3	Path 1°
42	30	$359 - 14$ to $358\frac{1}{2} - 15$	2	2	Path 1°
43	Oct. 8	$27 + 36$	4	4	
44	25	$22 - 18$	2	2	
45	31	$54 + 7$	2	4	Slow, 1 sec.

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March 1881.

of Radiant Points of Meteors.

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No.	Date.	Position. R.A. Dec.	No. of ↓'s.	Weight.	Remarks.
1	1880, Jan. 5-10	140° + 7°	7	3	Meteors generally bright with medium length of path and velocity, and leaving persistent streaks. 5 seen during half an hour on the 7th. Confirms Tupman's position at 145° + 5°, Jan. 4-11, '70.
2	2	227° + 48°	6	2	Meteors quite bright, long, and generally rather slow, all recorded from 7 to 8 hours.
3	Feb. 6-8	130° + 22°	3	3	Meteors faint, short, and rapid.
4	8, 9	155° + 20°	3	3	Meteors rather bright, short, and rapid. Schiaparelli and Zezioli at 153° + 21°. February 3.
5	1879, April 12-26	206° - 8°	5	4	Meteors quite bright, short and rather slow, position very accurately determined from a 2nd mag. stationary meteor recorded on the 14th.
6	20-26	242° + 24°	5	2	Meteors quite faint, short, and rapid. A feeble return of the Coronids.
7	20-22	245° + 50°	3	3	Meteors quite faint, short, and rapid; position well deduced. Draconids No. I.
8	22-26	253° + 5°	5	4	Meteors bright, short, and rapid: position well deduced from a stationary meteor = 1st mag. recorded on the 23rd.
9	19, 20	272° + 41½°	4	4	Meteors quite bright, short, and rapid, with streaks: blue probably a branch of the Lyraids?
10	19-21	274° + 34°	10	3	Meteors generally bright, short, and rapid, and of an orange colour. Lyraids, position quite well determined.
11	June 13-23	283° - 12°	9	3	Meteors generally very brilliant, short, and of medium velocity, two = γ in brightness and two = 1st mag. *: the brightest were of an orange colour.

No.	Date.	Position. R.A. Dec.	No. of ↓'s.	Weight.	Remarks.
12	1879, June 13-24 1880, June 29 29	307 + 5 304 + 3 295 - 1	4 5 4	3 3 3	Meteors bright, short, and rapid. Aquilids? Meteors rather faint, generally rapid, and of medium length. Meteors generally quite bright, short, and rapid, possibly two distinct showers in this region?
13	1879, July 13-24	307 - 5	4		Meteors bright, short, and rapid. Aquilids. Compare with No. 12.
14	17-20	318 + 22	6	4	Meteors generally very bright, short, and rapid; position well determined.
15	13-24	338 + 18	5	4	Meteors generally faint, short, and rapid, position accurately deduced. Pegasids II.
16	1880, July 28	341 - 10	4	3	Meteors quite bright, short, and of medium velocity. Denning, = 341° - 13° July 21-29.
17	28-31	330 - 6	20	4	Meteors very bright, and generally slow, position very accurately deduced. Max. 29-30. Aquariads.
18	28-30	328 - 15	8	4	Meteors generally rapid and very bright. Max. 28th, position accurately determined. Nos. 16, 17, and 18 possibly all one shower?
19	29-31	315 + 5	12	4	Meteors of medium brightness, short, and rapid; position accurately deduced. Max. 29. Active shower.
20	July 30, Aug. 1	294 + 13	8	3	Meteors of medium brightness, short, and rapid. Max. July 31. Confirms Heis at 294° + 13° July 26-31.
21	30 1	303 + 8	4	2	Meteors very bright and slow; not accurate. Heis July 14, August 31 = 305° + 7°.
22	29 7	356 + 25	6	2	Meteors of medium brightness, short, and rapid, not accurate.
23	29 1	331 + 53	5	3	Meteors generally bright, long, and rapid.

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No.	Date.	Position. R.A. Dec.	No. of ↓'s.	Weight.	Remarks.
24	1880, Aug. 8, 9	5 + 75 °	6	3	Meteors very bright, short, and rapid.
25	1879, Aug. 10-12	5 + 57	5	3	Meteors very bright, short, and rather slow.
	1880, Aug. 8, 9	5 + 55	14	3	Meteors quite bright, of medium length and generally rapid with streaks. Active shower.
26	8, 9	44 $\frac{3}{4}$ + 56 $\frac{1}{4}$	48	4	Meteors generally bright, short, and rapid with streaks; position very accurately determined from several short tracks near focus and one perfectly stationary meteor = 1st mag. and visible 2 seconds. Perseids. Hourly No. on 8th 16↓s. 9th 28↓s. 8th = R.A. 38° + 56°.
	1879, Aug. 10-12	44 $\frac{1}{2}$ + 57	106	4	Meteors bright, short, and generally rapid with persistent streaks. Position very accurately determined from 20 paths exactly mapped. Hourly No. 24 on 10th, 13 on 11th, and 5 on 12th. Very meagre display.
27	1880, Aug. 9	55 + 57	6	4	Meteors bright, short, and rapid with streaks. Position accurately deduced from several short tracks and one nearly stationary meteor. Probably branch of Perseids?
28	8, 9	270 + 69	4	4	Meteors bright, short, and slow, accurate. Heis, August 13 31 = 275° + 69°.
29	8, 9	332 + 60	7	3	Meteors generally not very bright, short, and rapid; principally seen on the 8th.
30	1879, Aug. 11	38 + 60	8	4	Meteors generally bright, short, and rapid; position very accurately deduced from 7 well-observed tracks, and one absolutely stationary of the 2nd mag. and visible 1 sec. Perseids.
31	10-12	17 + 42	4	2	Meteors bright, short, and rapid; strongly suspected.
32	10-12	23 + 37	4	3	Meteors rather bright, short, and rapid; position well determined.

No.	Date.	Position. R.A. Dec.	No. of ↓'s.	Weight.	Remarks.
33	1879, Aug. 10-12	180° + 78°	6	2	Meteors faint, long, and rapid; strongly suspected.
34	7-12	344 + 42	6	4	Meteors rather light, short and rapid; position accurately deduced. Honorids.
35	7-12	358 + 55	7	3	Meteors very bright, short, and rapid; position quite well determined, possibly same as No. 25?
36	20-23	240 + 12	4	3	Meteors rather bright and short with a medium velocity.
37	20-23	258 + 20	7	3	Meteors faint, short, and rapid.
38	1880, Aug. 28, Sept. 4	352 + 27	7	3	Meteors quite bright, short, and slow.
39	28	348 + 17	3	4	Meteors bright, short, and rapid; accurate.
40	31	2 + 16	5	3	Meteors short, not very bright, and rapid.
	1879, Sept. 9-11	2 + 15	9	4	Meteors generally faint, short, and rapid; accurate, principally seen on the 11th. Pegasids III. Heis = 1° + 14° September 16-31.
41	15-20	10 + 35	10	4	Meteors faint and rapid, with medium length of path; 5 of the number seen on the 17th. Andromedes I.
42	7-17	346 + 45	8	3	Meteors generally faint and rapid, with medium length of path. Radiant point appeared to shift from 343° + 45° to 349° + 45°.
43	1880, Sept. 25, Oct. 5	8 + 22	7	2	Meteors short, quite bright, and very slow; rather diffuse.
44	29	24 + 17	10	4	Meteors generally bright, short, and quite slow; average length of path 7° and duration about 1 sec. Very close agreement with the radiant point of the comet of 1769 = 24½° + 17° September 28.
45	Oct. 1	16 + 50	4	2	Meteors short, faint, and rapid; strongly suspected.
46	2-5	15 + 40	5	3	Meteors not very bright, rather short, and slow.

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No.	Date.	Position. R.A. Dec.	Nos. of ↓'s.	Weight.	Remarks.
47	1880, Oct. 5-8	27 + 24	5	3	Meteors bright, generally short, and rapid.
48	6, 7	50 + 10	4	3	Meteors quite bright, of medium length, and slow.
49	1879, Oct. 14-19	23 + 20	4	4	Meteors rather bright, short, with medium velocity; position well determined; one nearly stationary meteor.
50	19	26 + 48	4	3	Meteors faint, short, and rapid.
51	19	44 + 18	4	3	Meteors rather bright, short, with medium velocity. Denning October 2-19, '77 = $47^{\circ} + 16^{\circ}$.
52	14-19	44 + 35	5	4	Meteors rather bright, short, and rapid; position well deduced.
53	19	48-4	4	3	Meteors bright, short, and rather slow; one nearly stationary.
54	19, 20	59 + 14	5	3	Meteors rather bright, short, and rapid. Taurids I.
	1880, Oct. 31, Nov. 3	60 + 18	5	3	Meteors quite bright, of medium length, and rapid.
	1879, Nov. 7-10	60 + 19	6	3	Meteors very bright, and generally slow, with long paths, orange coloured.
55	Oct. 19, 20	59-13	4	3	Meteors very bright, slow, and short. Tupman, October 5 6, '69 = $54^{\circ} - 14^{\circ}$.
56	14-20	73-53	8	2	Meteors generally bright, slow, and of medium length, not accurate.
57	19	84-26	4	4	Meteors rather bright, short, and rapid; well determined.
58	19	92 + 15	8	4	Meteors not very bright, short, and rapid, with streaks; position very accurately deduced. Orionids.
59	19	350 + 50	4	3	Meteors faint, short, and rapid.
60	1880, Oct. 24	26 + 13	6	4	Meteors of medium brightness and length, and quite slow; accurate.
61	25-31	3 + 42	7	3	Meteors short, faint, and rapid.

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No.	Date.	Position. R.A. Dec.	No. of ↓'s.	Weight.	Remarks.
62	1880, Oct. 31, Nov. 2	54 + 7	6	3	Meteors very bright, short, and slow.
63	24 3	43 + 24	7	3	Meteors short, slow, and bright.
	1879, Nov. 7-10	47 + 24	7	4	Meteors quite bright and short, with medium velocity, position very accurately determined from several short tracks, and one nearly stationary.
64	1880, Oct. 29, Nov. 3	325 + 65	4	2	Meteors of medium length, bright, and slow, with streaks, orange; strongly suspected.
65	1879, Nov. 10	42 + 43	4	3	Meteors faint and rapid, with medium length of path: strongly suspected.
66	10	65 + 30	5	3	Meteors bright, short, and rather slow; orange.
67	15	151 + 22	7	4	Meteors of medium brightness, short, and rapid, with streaks accurate. Leonids.
	1880, Nov. 11, 12	148 + 22	12	3	Meteors quite bright, short, and rapid, with streaks; Leonids.
68	1879, Nov. 15	146 + 1	3	3	Meteors short, and rather bright, orange; strongly suspected.
69	1880, Nov. 21-28	81 + 23	5	3	Meteors rather bright, of medium length, and slow. Taurids II.
	1879, Dec. 7-12	82 + 23	5	3	Meteors rather bright, of medium length and velocity. Taurids II.
70	7-12	75 + 45	5	3	Meteors short and bright; and radiant point very near <i>α Aurigæ</i> ; strongly suspected.
71	7-12	100 + 35	13	3	Meteors generally faint, long, and rapid; position well deduced; possibly a branch of the Geminids?
72	7-12	110 + 33	20	4	Meteors bright, very short, and rapid; position well determined. Geminids.